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New technology and exchange formats *

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The last 15 years have seen a tremendous growth in the exchange of bibliographic records between organizations which has been assisted by advances in information technology. The library community has developed UNIMARC and the abstracting and indexing community are using the UNISIST Reference Manual to facilitate the transfer of bibliographic data between databases. Unesco is establishing a Common Communication Format in an attempt to bridge the gap between the library and A & I communities. However, different practices in record creation between organizations providing records mean that records from different sources cannot always be merged comfortably into one database even if they have been converted into the same exchange format.

One way of achieving the necessary compatibility between records from different sources is by editing the records as they are received. This can be time-consuming and can make the use of records from outside sources uneconomic. New technology, in the form of intelligent terminals, can make this more of a practical proposition. Records can be obtained on-line from external databases and can then be changed either by the intervention of the operator or by programs in the terminal which can make changes to the data or tags of particular fields before adding the records to the file. Very little research has been done on the economics of using intelligent terminals to edit records but this kind of operation is likely to increase in the future as more bibliographic systems using intelligent terminals are developed.

1. Development of exchange activities

Over the past 15 years a great deal of effort has been expended in establishing procedures for the exchange of bibliographic data in machine-readable form. By bibliographic data is meant bibliographic records, citations of books, serials, films, sound recordings, journal articles, indexed by their titles, the names of their authors and editors, and by various kinds of subject access such as key

words, classification scheme notations and terms from controlled language systems such as thesauri or subject heading schemes. This paper hopes to show how modern technology can assist the aims of universal bibliographic control, well-documented as for example in Clarke [4], by helping to disseminate more widely those records that have been created by bibliographic agencies throughout the world.

Many systems now exist for exchanging bibliographic data. The first large scale efforts began in the United States Library of Congress. They developed the MARC exchange format in 1966 [1] and after an experimental trial they improved this in 1968, co-operating with the British National Bibliography Ltd. (BNB), a private non-profit-making organization which produced the bibliography of British publications. As a result of this, what was probably the first truly international exchange format came into being, and the BNB and later the British Library were able to take Library of Congress records and make use of them for adding to catalogues they produced for other organizations.

Avram, who fostered the development of MARC in the Library of Congress, refers [2] to the elements of an exchange format as stated in the foreword to the UNIMARC document [12]. These are:

- (1) The structure of the record, which is the physical representation of information on the machine-readable medium.
- (2) The content designators for the record, which are the means of identifying the data elements or providing additional information about a data element.
- (3) The contents of the record, which are the data themselves, i.e. the title, name of the author, etc.

It is interesting to take each of these elements of the exchange format and see how far standardization has been applied to each.

1.1. Record structures

There has been almost universal agreement on the structure since *Iso 2709* [7] was adopted as the format structure for the exchange of bibliographic

* The opinions expressed in this paper are those of the author and not necessarily those of the British Library.

data in 1973. Even before that, it had been adopted in certain countries as a national standard.

1.2. Content designators

The content designators of the records (commonly called the tags) have not been subject to the same degree of agreement and indeed a number of these systems now exist. International systems have tended to be based on MARC or the *Reference Manual*, and content designators have been designed to serve the needs of particular user groups.

1.2.1. MARC

MARC is a generic name for the system of tags used by many national libraries around the world and also by their customers, libraries in each country who subscribe to records from the national database. As used by the British Library and the Library of Congress, it tends to be biased towards producing the record for the library catalogue or the national bibliography. The order of its tags is based on the order of data needed when processing records to produce a catalogue entry and the idea of a main entry and added entries is enshrined in the tagging structure. Many countries have their own individual MARC formats which are to a greater or lesser degree compatible. The British Library takes records produced by the Library of Congress and converts them from US MARC to UK MARC without too much difficulty. To avoid the problem of the necessity for numerous bilateral conversions, the IFLA Sections on Cataloguing and Mechanization joined forces to produce an international MARC format known as UNIMARC [12]. At the same time, the order of tags was rearranged and UNIMARC looks to be a more general purpose format than the individual MARC formats with which it has of necessity to be compatible.

1.2.2. Reference Manual

The *Reference Manual* was originally developed by the UNISIST/ICSU-AB Working Group on Bibliographic Descriptions, a group of experts who brought with them the experience of organizations which had already developed mechanized information processing systems particularly among the abstracting and indexing services who tend to be more diverse in their practices than libraries. Now in its second edition [5], the *Reference Manual* has

moved away from serving exclusively the needs of one particular user group and of having one particular output in mind. It is able to cope equally well with a contribution in a journal as with an ordinary monograph standing alone. However, due to constraints placed on its development by the standard record-structure (ISO 2709) and the lack of standard record linking techniques, it cannot deal easily with complex record structures, for example a complete set of journal articles in one issue of a journal. It forces records to be categorized according to one or more of four bibliographic levels, analytic, monographic, serial and collective, and although the majority of records fit into this structure, a few do not. It repeats content designators for some of the most common data elements at each level, e.g. author and title, but in the case of other data elements, thesis note, publisher, it does not give this opportunity. Nonetheless, it serves very well the purpose for which it was primarily intended, namely as a format to store records of journal articles, monographs and serials (in that order) for exchange between abstracting and indexing (A&I) services.

1.2.3. Unesco Common Communication Format

In the middle seventies, Unesco became aware of the problems caused by the existence of the two formats, so they sponsored the International Symposium on Bibliographic Exchange Formats, held in 1978. This was very successful in bringing together experts from different sectors of the information community and in putting an end to the tendency towards polarization between the libraries and information services. Resulting from recommendations made at the Symposium [6], Unesco set up the Ad hoc Group on the Establishment of a Common Communication Format, and this format has been developed over the last 6 years with the prospect of its being published shortly [10]. The Group quickly realised that the requirements of all sectors of the information community are very much the same. Basing the format on a set of data elements mandatory for all records—a set which is felt to be necessary in the record for the purposes of identifying the item to which it refers, the Group has added other optional data elements to complete the format. A very much streamlined method of record linking applicable throughout the format will enable records in other formats such as MARC, MEKOF and the *Reference Manual*

to be converted into the Common Communication Format.

1.2.4. Other international exchange formats

Mention must be made of AGRIS and INIS, both of which owe various features to MARC. These formats are used internationally for the exchange of bibliographic data relating to agriculture and atomic energy respectively. Although input of data in these formats is decentralized, the use of the formats is very much centrally controlled, especially with respect to cataloguing rules for record content.

1.2.5. Multiplicity of exchange formats

As can be seen, a number of different systems exist for the exchange of bibliographic data. Theoretically the existence of a number of formats for coding the items in a bibliographic record amounts only to an expensive nuisance, since it is not difficult to write computer programs to convert data from one format to another. In practice, however, it probably stifles the exchange of bibliographic data since the writing of these programs costs time and effort and has to be scheduled within an institution's data processing department's programme where it is likely to get low priority; so it is fair to say that very little exchange of bibliographic data occurs other than between organizations who use the same bibliographic exchange format.

1.3. Record contents

To see how far record contents are standardized, we can turn first to UNIMARC, a format potentially capable of accommodating records of documents in a variety of materials, though at the moment specialized fields are provided only for books, serials and cartographic materials. The data, as is equally the case with the other international exchange formats, can be manipulated in such a way as to provide varying types of output. The aim of UNIMARC is to be a set of conventions for holding data in machine-readable form coded in such a way that it can be translated readily into the formats used by organizations who wish to take records from other sources. This ensures that a recipient of a record knows what to expect in a record and can identify each data element. However, there is a further stage in the life of an

exchanged record. Having been received, it has to be merged into the database of the recipient organization. The fact that each data element is identifiable certainly makes this process possible in the widest sense. If the database receiving the record is an on-line database and has inverted files or indexes of elements like author, title, International Standard Numbers, then these can readily be provided from the records. But if the aim is to incorporate the records in a catalogue or bibliography in printed form or microform, a quick glance at records from different sources shows that they are never as compatible as one would like. Records in UNIMARC may be taken as a case in point. UNIMARC is the exchange format intended for use within the library community, more specifically the national libraries. Indeed a number of national libraries including those of Australia, Canada, Japan, Hungary, South Africa, the United Kingdom and the United States have already agreed to use UNIMARC as their exchange format [12, p. ix]. Nevertheless, a UNIMARC record will have originated in a national format and will tend to bear the marks of the cataloguing rules originally used in the creation of the record.

This holds true of records exchanged between any kind of bibliographic agency. Within the national library community, the different libraries use the records they create for much the same purposes as each other, inclusion in printed bibliographies and for on-line retrieval of the records. But though the records are intended for a similar purpose, they have often been prepared using different cataloguing codes and this is where any problem concerning record content lies. Problems are caused by absence of expected data elements (one code does not regard a particular data element as important) and by differences in form of a data element. Even more difficult to resolve, one format may always record a particular data element in a form suitable for inclusion in a catalogue entry, though not suitable for retrieval. Take for example government publication numbers. These occur in UK MARC in field 538 *Number borne by item note*. On the other hand abstracting and indexing services favour the inclusion of numbers of this kind in fields intended for inversion, especially as these documents often have no standard number. Since the primary function of the MARC formats (historically at least) is to provide catalogue entries, and the user of a catalogue can

identify a *Number borne by item* by experience when looking at a catalogue entry, there is no need for further specification. But if such a record were taken by an A & I service, the government publication number could be isolated only by manual inspection which, if applied to every record, would be uneconomic. The same is true in the case of fields containing subject access data. There are no international standards for subject headings. UDC is a classification scheme with the status of an international standard, but comparatively few records are indexed by this scheme, and even when it is applied it guarantees no consistency of treatment. Thus even the data elements catered for in a format like UNIMARC will often not be present in records converted into that format, even though they could logically have been applied to the records.

1.3.1. Record contents differing in form

Turning to the data elements that are consistently present; authors, titles, standard numbers. Here problems arise. Searching different databases for the same title reveals that they are sometimes recorded differently: a title in a foreign language will be translated into the language of the database in some databases. Names of authors are even more likely to be presented in different ways. To take an example. William Shakespeare may be recorded as *Shakespeare, William* or *Shakespeare, W.* He has so many books to his name that if we have a printed catalogue containing records from different sources where his name has been recorded differently, there may be a number of pages between records entered under one form and records entered under another. A further complication arises when, as is often the case in library catalogues, the dates of birth are added to an author's name in those cases where it is necessary to make it uniquely distinguishable from other authors of the same name in that catalogue. There have been one or two authors named William Shakespeare in addition to the well-known poet and playwright. Databases holding the other names should add dates to all three, those holding only the one name will not add any date. Thus, if records from each category of library are merged, some will have the dates and others will not. This is clearly another instance where there is no avoiding the fact that records will need editing as they are merged. Incidentally, the *Refer-*

ence Manual contains a data element *search name* designed to overcome this problem. This involves taking the *key name*, the part of the name under which it is entered in lists, and up to two initials. This can then be used for filing. This was included in the *Reference Manual* at the request of a group of A & I services, the Four Ways Group¹, and is required by A & I services, even more than by libraries, since among A & I services there is even less consistency in treatment of names.

One might expect that these problems outlined above would disappear if there was a common set of cataloguing rules. Even that would not be sufficient grounds for optimism! The British Library and the Library of Congress both use the same 2nd edition of *Anglo-American Cataloguing Rules*. But because of questions of interpretation and practices evolved by each agency where rules leave a certain amount of discretion, as well as the fact that the collections are different and different authors are distinguished by date in each catalogue, forms of names between the two organizations have not yet been standardized. This means in practice that when records are taken from the Library of Congress database and incorporated into any British Library catalogue there is no guarantee that the forms of names of persons or corporate bodies will be the same, and in order to ensure a consistent catalogue all records will have to be inspected.

1.3.2. Detection of duplicates

To a large extent, when any record sharing activity takes place, there is always in practice the problem of duplicate records. Large databases under the control of one organization but taking records from more than one source tend to detect duplicates by fairly simple and therefore ineffective procedures. The BLAISE MARC database of the British Library holds records originating within the British Library and records from the Library of Congress, some of which started out being created in the National Library of Canada. Those records known to relate to British publications are eliminated from the records taken from the Library of Congress database since they ought to be pre-

¹ The Four Ways Group consisted of representatives of ASIDIC, EUSIDIC, ICSU-AB and NFAIS and this request was contained in unpublished documentation prepared for a meeting which took place in June 1977.

sent in that portion of the BLAISE MARC data base produced for BNB. Library of Congress records used to contain an indication of whether a record was related to a record in the BNB and hence in the UK MARC database, but this information is not available in the Library of Congress records produced now. A new procedure has been devised which involves looking at the country of publication of the document represented by the record, but this is not effective as it causes records to be dropped which for one reason or another have not been included in the UK MARC file but which relate to British publications; and it can cause records to be retained which, because they have an American distributor, are in the Library of Congress database denoted as being US publications. However, the problem of duplicates in the BLAISE MARC file is not a serious one. To start with, the record for one item will not often occur more than twice since there are only two likely sources of records. Secondly the use to which it is mostly put, information retrieval by subject or retrieval of records for inclusion in catalogues, means that if two records are found instead of one for the same item, it will cause little inconvenience. Serious problems arise when a large number of organizations input into one database. A true shared cataloguing co-operative where records come from many sources and are used for retrieving location data needs to have only one record per item. Otherwise, a searcher may retrieve one record with two or three locations and thereby miss one record with more locations which may have been of use to him. Williams and MacLaury describe a prototype system for the detection of duplicates which was tested on OCLC as well as on other databases [13]. Another area where record matching is important is in exchanging records of journal articles. With books and serials, especially recent ones, matching on ISBN or ISSN alone solves many problems. With journal articles there is as yet no unique key to each article although work has been going on in ISO to develop a bibliographic identification [8]. Moreover, there is potential for a large number of duplicates in a file since a number of agencies are involved in preparing records. Each agency is often very much subject-bound, but there is a large amount of overlap in the subjects they cover and, of course, many articles are relevant to a number of disciplines; an article on the use of a certain drug to treat cancer could easily occur in data-

bases relating to chemistry, pharmacy, medicine and other databases relating to subsets of these disciplines. This will increasingly become a problem for those systems for which the UNISIST *Reference Manual* exchange format was devised, abstracting and indexing services who wish to exchange data. For them, record matching will become more essential as records come from a larger number of sources. Checking certain key fields of any record added to a file against all existing records is impractical and uneconomic because of the amount of time the computer would take to do it. And many duplicates still escape the net because different cataloguing codes and local practices used by the recording agencies result in records that look different to the computer, and only the human eye can tell that they are records relating to the same item.

New technology is not going to help this problem very much. Even if computer processing became so cheap that lengthy computer programs checking records field by field became feasible, these programs would still have to be written, the algorithms would still have to be devised by people familiar with each format and there would still be records which looked the same to the computer which only a very complex algorithm, or the human mind, could distinguish or isolate as constituting duplicates.

1.3.3. Problems resulting from conventions in the source format

In a test made on UNIMARC in which nine national libraries took part², a number of instances came to light where one or another source format was not specific enough in a particular area to provide codes to add to data, such as a code indicating whether a particular author name is the main entry in a bibliographic record, the name of a joint author or a secondary entry. UNIMARC has a 'fill character' to denote that a code required in the exchange format is not, or cannot be, applied from data presented in the source format at conversion. Depending on the use to be made of the records taken from another source in an exchange format, or sometimes only on the sense of perfec-

² A test was conducted by the Deutsche Bibliothek in which different national libraries contributed records converted into UNIMARC which were then compared. The results have not been published.

tion present in the receiving organization, a great deal of work may be done to change the records manually, inserting values in codes sometimes even necessitating reference to the original document to which the record refers.

1.3.4. Achieving internal consistency in files

When records are taken from different sources, even if they are in the same exchange format, the merged files may lack a certain amount of internal consistency. Since exchange formats are often developed as a compromise between existing formats, they are not always quite equivalent to the source formats in all their data elements with respect to both definition and form. And as mentioned, different cataloguing codes result in differences of treatment. So what can be done? Two options are available:

(a) We do not concern ourselves with the standard of data: if we wish to produce a printed listing of the merged files, it will most probably be untidy and will contain duplicate sequences of name access points, inconsistently presented records and duplicate records with slight differences of content.

If we wish to use the file for on-line searching of records, there will be no serious problems as a result, since in on-line data retrieval one is accustomed to lower quality of output, and one does not see on the screen a large number of records at once. Moreover the searching strategy used can compensate for the roughness of the data.

(b) We edit the data on adding it to the database. This can be expensive, but new technology can help us here and this is dealt with in the rest of the paper.

2. Intelligent terminals

Intelligent terminals are devices that can receive data from remote databases and at the same time do some processing on the data received. The intelligence amounts to memory in which programs can be stored to manipulate the data. Intelligent terminals can be used to add further formatting to records retrieved on-line to increase their readability. This may be cheaper than having the database host's computer do this, and it will of course be more flexible. Intelligent terminals can be programmed to dial up the host computer

automatically to provide better accuracy and to save time. They are basically microcomputers with telecommunications facilities added. Intelligent terminals are already used for bibliographic purposes and a full account of their use is found in Noerr [9]. Also, a system has been developed by the British Library for data input using an intelligent terminal specially tailored to take records on-line from BLAISE and edit them [3]. The system called CORTEX runs on an ACT Sirius 1 with 128 kilobytes of memory and 1.2 megabytes of disk storage. Having downloaded records and edited them, the system enables the transfer of the records to a floppy disk. Alternatively, they can be copied down the telephone to the British Library, either way to be included in the library's own catalogue file for inclusion in the next issue of the catalogue. Incidentally, one of the uses proposed here for intelligent terminals is the conversion of tags from one format to another. CORTEX is not usually used to convert tags or other kinds of codes within records since the British Library converts Library of Congress records in US MARC format into UK MARC format on its mainframe computer before adding them to the BLAISE database. Nevertheless, this system could be used for that purpose if users wished to change tags for their own database.

2.1. Intelligent terminals used for record exchange

As mentioned earlier, the problems of assimilating records from other databases are two-fold, differences in form of content and differences in types of data recorded.

There follows a short description of how one can use an intelligent terminal to add records to one's own database. Imagine a cataloguer in a library with a pile of books in front of him which he wishes to add to the catalogue. He first of all has to retrieve the records relating to those volumes from the remote database. He can do this by keying in an ISBN or in the absence of an international standard number he can search for author and title, using the command language and other search procedures expected by the system which hosts the database. In order to economise on the use of the telephone and computer connect time, it is possible to prepare the search in advance, store it on the terminal and by depressing one reserved key send the search down the line to the computer.

Those records that are retrieved are then displayed on the screen as they come in and are copied to disk. The operator can then look at the records one by one and edit them where necessary and add the library shelf mark or other local data. Figure 1 shows how a record might look on the screen using

UK MARC tags. Each field starts with a 3-digit tag followed by two indicators and a repeat indicator. A filter could have been set up which would allow only certain fields to be displayed in the record. If, for example, in our database we never want to see the *Dewey Decimal Classification Number*, 18th ed., we could filter out field 081.

Some systems allow small programs or sub-routines to be written by the user to cater for any special requirements he might have. The keyboards usually have specially designated keys. As soon as a record is retrieved the operator places the cursor over the first character of the record and pushes one of the special keys and a number of changes are made to the record which have been preprogrammed. One sequence of tags may be replaced by another; subfield codes in a particular field may be replaced by punctuation; punctuation may be inserted at any point. In Figure 1, a 'p' standing for 'pages' in field 300 subfield \$a could have a stop after it, which the British Library omits as part of its house style. This can be

inserted automatically. As soon as the automatic alterations have been made to the record, the new record is displayed on the screen, the cursor at the start of the first line. A further facility allows the searching for any piece of text in a file. If for example 'Bibl.' is to be expanded to 'Bibliography', a search can be made for 'Bibl.' and all the records containing 'Bibl.' will be displayed on the screen. They can then be amended on the screen and returned to the file in their new form. Incidentally, any new data may be inserted after depressing a particular function key. If a field not in the source is required in each record, for example a shelf mark, the program can cause the appropriate tag to be displayed and will insist that some data be entered in that field by refusing to allow the cursor to pass that field until it is edited. When the operator is satisfied that the field is correct, by depressing a particular reserved key he will cause the cursor to jump down a field signifying that the field has been accepted. Alternatively, any field can first be amended by using screen editing facilities; if a name heading has to be changed to make it consistent with the rest of the file then the operator types the new text over the old and finally enters the field by depressing the appropriate reserved key.

```
001      0855203897f
008      820726s1982      en a      W      00011      eng      f
015.00/0 $aB8122583f
021.10/0 $a0855203951$bv$cpbk$d$8.50f
043.00/0 $aew----f
050.00/0 $aHC241.2f
081.00/0 $a338.91$b4$c18f
082.00/0 $a337.1$b42$c19f
245.34/0 $aThe Collaboration of nations$ba study of European
        economic policy$eedited by Douglas Dosser, David Gowland
        and Keith Hartleyf
260.00/0 $aDxford$bMartin Robertson$c1982f
300.00/0 $ax,252p$bill$c24cm$ecasedf
350.00/0 $af19.50f
504.00/0 $aBibl.f
610.20/0 $aEuropean Economic Communityf
651.00/0 $aEuropean Economic Community countries$xEconomic
        integrationf
700.11/0 $aDosser$hDouglasf
700.11/1 $aGowland$hDavidf
700.11/2 $aHartley$hKeithf
900.10/0 $aGowland$hD. H.$xSee$aGowland, David$z700/1f
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Fig. 1. A formatted record on the terminal's screen.

2.2. Summary of the use of intelligent terminals

In conclusion, any changes required in the record can be made using an intelligent terminal. If these are consistently applied changes, then they can be effected automatically by a computer routine in the terminal. Other changes can be made as required by the cataloguer on inspection of the record which can then be added to a file on floppy disk for incorporation in the main file, which might be a file used to produce hard copy catalogues or a file which will be accessed for on-line information retrieval. The types of changes which are likely to be required to be made to records are:

(a) *Conversion of content designators* (including tags, indicators and subfield identifiers). This would be done automatically in most cases, though tags where there was no one-to-one correspondence between formats could be highlighted on the screen for manual intervention.

(b) *Replacement of headings*. Depending on compatibility of data in the files and the source from which the records are taken, all the headings may have to be checked.

(c) *Amendment of coded data*. Often coded data is treated differently between formats. The majority of these may be converted automatically. Others may require manual intervention. If the source format does not indicate which heading is main entry and the receiving format requires this, this may have to be added manually.

(d) *Punctuation and filing signals*. These may be added by a combination of automatic insertion and operator insertion.

(e) *Addition of data elements not present*. Some of these may be important to the users of the records and they can easily be added using the editing facilities of intelligent terminals.

3. The future

This paper was inspired by discussions that the author has had over a number of years as to whether it really is economic to take records created by other organizations and add them to one's own file, if one is not prepared to accept the records without any alterations other than the addition of local data. Intelligent terminals can be used to speed up the process and enable the operator to

see what record is going to be added to the file rather than making alterations remotely. This paper has dealt with what is possible rather than what is operational, since despite the proliferation of international exchange formats, very little data is exchanged internationally. Unfortunately, no data is available on the amount of staff time involved in amending records in the way described above as compared with the time taken to catalogue a record from scratch, so no conclusions can yet be drawn as to the real potential for intelligent terminals in editing records. It may therefore turn out that for files which demand a high level of internal consistency, it will always be cheaper to catalogue one's own records as happens at present in most of the national libraries of the world. But given that hardware costs are falling, when once software becomes available to fulfil the functions outlined, it is expected that systems of this kind will play an important part in the international exchange of records between databases in different countries, promoting the free flow of information and expanding their capacity to exchange, store and use the information. These are major objectives of the Unesco General Information Programme as stated in the *Draft Medium Term Plan* (1984–1989) produced by the Unesco General Conference in 1982 [11], and in an attempt to achieve this Unesco hopes to establish computer software which will, amongst other things, enable conversion of data between international exchange formats.

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